THE MORPHOLOGY, TAXONOMY, AND BIONOMICS OF THE NEMERTEAN GENUS CARCINONEMERTES

BY
ARTHUR GROVER HUMES
A.B., Brown University, 1937
M.S., Louisiana State University, 1939

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
ZOOLOGY IN THE GRADUATE SCHOOL OF THE
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Dr. R. R. Kudo of the University of Illinois has translated from the Japanese a paper by Takakura, which will, when republished in part, be of great interest to students of nemerteans. For his translation the writer is particularly grateful, because without it much of the taxonomic and morphological material in this study would be incomplete.

Dr. H. J. Van Cleave, under whose direction this study has been made, has offered his friendly encouragement and criticism throughout the work.

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Preserved specimens of Carcinonemertes were found on the egg masses of ovigerous crabs in museum collections. Live specimens present on the edible blue crabs in the region of Grand Isle, Louisiana, provided an opportunity for study of the morphology, life history, and ecology.

A new variety, *Carcinonemertes carcinophila imminuta,* is described from Grand Isle, Louisiana. In these worms distinct sexual dimorphism in size and color is found. Some individuals reach sexual maturity at extremely small sizes, much smaller in fact that any previously known mature nemerteans. The morphology of immature and adult worms is described in detail. Cephalic muscle fibers are present along the rhynchodaeum and around the brain and esophagus. The anterior, non-muscular part of the esophagus is capable of complete eversion, bringing the posterior muscular part outside the body where it acts as a sucking and pumping organ. The proboscis is reduced, and is wholly incapable of self-initiated movements or eversion. The anal blood vessel and nerve commissures are both ventral to the posterior end of the intestine.

The male reproductive system of *C. c. imminuta* contains a unique and hitherto generally unknown apparatus, which the writer proposes to name Takakura's duct. This consists of vasa efferentia, vas deferens, and seminal vesicle, and serves to transport the spermatozoa from the testes to the lumen of the posterior end of the intestine, whence they are expelled to the outside of the body.

Ciliated embryos develop inside the egg membranes. The free-swimming larva bears at each end a cirrus and the entire body is ciliated. Two ocelli are usually present, and the larvae are positively phototactic in contrast to the negative phototactic adult worms. Although no direct observations were made by the writer, it is probable that the ciliated epithelium

is not shed as claimed by earlier authors and that the only external change in the metamorphosis to a crawling worm is the loss of the cirri. In the larva there can be seen indefinitely defined rudiments of the brain, esophagus, and proboscis.

The nemerteans on the crab gills form capsules by cementing the two adjacent lamellae together around themselves. All the worms on the egg masses, except the very minute ones, live in mucous, lapilliform sheaths which they apparently secrete. In branches of these sheaths the female worms deposit their eggs.

The life history of *C. c. imminuta* is intimately related to that of the host crab. The positive phototaxis of the free-swimming larvae aids them in coming in contact with the crabs which frequent the surface of the water. Immature crabs of both sexes and adult males are only rarely infested, since they molt relatively frequently. Adult females, which do not molt, are very commonly heavily infested. The shallow water, the comparative lack of strong currents, and the abundance of crabs all aid the larvae in coming in contact with new hosts. There is no correlation between the presence of nemerteans and the presence of the barnacle *Octolasmis mülleri,* or between the size of the adult female crabs and infestation with nemerteans. The worms migrate from the gills to the egg masses when the crab comes into berry and back to the gills when the crab eggs are hatched. Worms become sexually mature only on the egg masses of the crab. The gonads in worms living on the gills are undeveloped. The nemerteans become sexually mature whenever the crab becomes ovigerous (in Louisiana from the last of March to the last half of October). During the cold weather, when the female crabs generally seek deeper water, the worms remain quiescent on the gills. Transmission of infestation is probably always by means of the free-swimming larvae.

The food of the nemerteans consists of the eggs of the host crab. The effects of the worms on the crabs are slight, and the worms are classified as ectoinquilines, rather than as ectoparasites. In heavy infestations the gill surface over which water

can flow is reduced. No injuries to the gills can be seen, and it is unlikely that the stylet can be extruded to pierce the chitinous gill covering.

At Grand Isle, Louisiana, *C. c. imminuta* was found upon *Callinectes sapidus, C. ornatus, Arenaeus cribarius, Portunus sayi, Hepatus epheliticus, Persephona punctata aquilonaris, Panopeus herbstii,* and *Menippe mercenaria.* Since on all except *C. sapidus* the worms were extremely few in number and small in size, it is concluded that *C. sapidus* is the normal host for these nemerteans in the Grand Isle region. Specimens of *C. c. imminuta* were also found upon *Portunus spinicarpus, Callinectes bocourti, C. marginatus, C. danae,* and *Cronius ruber,* from the West Indies and South America.

A new host, *Euphylax dovii,* for *Carcinonemertes epialti* Coe 1902 is reported from Payta, Peru.

Carcinonemertes mitsukurii Takakura 1910 differs from *C. carcinophila* in that the anal blood vessel commissure is dorsal instead of ventral to the posterior end of the intestine. Specimens which the writer believes should be temporarily at least assigned to *C. mitsukurii* were found on *Charybdis miles, C. cruciata, C. erythrodactyla,* and *Portunus pelagicus,* all from the Pacific Ocean.

A new species, *Carcinonemertes coei,* is described from Zanzibar on *Charybdis natator.*

The family Carcinonemertidae Sumner, Osburn, and Cole (1913) is diagnosed to include the single genus Carcinonemertes.

Although superficially the presence of Takakura's duct seems to show a relationship with the Acoela, the writer believes that the structure is a separate development, independent of possible acoelan ancestry.

Of the 334 crabs examined in the collections of the two museums, 29, all of them belonging to the family Portunidae, were infested with nemerteans. At the present time there are 26 species and 1 subspecies of Brachyura (20 of them belonging to the Portunidae) and 1 species of Anomura known to be infested with Carcinonemertes. The life habits of the

Portunidae contribute to their heavy infestation. There is little or no host specificity in the genus Carcinonemertes Species belonging to this genus are distributed in the littoral zone in temperate and tropical seas around the world.

VITA

Arthur Grover Humes was born at Seekonk, Massachusetts, on January 22, 1916. He attended elementary schools there and in Pawtucket, Rhode Island, graduating from the Pawtucket Senior High School in 1933. He received an A.B. degree *magna cum laude* from Brown University in June, 1937. During his senior year he was elected to membership in Phi Beta Kappa and to associate membership in Sigma Xi, and was awarded final highest honors in biology. In the summer of 1937 he attended the field course in zoology at the Cold Spring Harbor Laboratory, Long Island, New York.

From 1937 to 1939 he held an assistantship in zoology at Louisiana State University, where in May, 1939, he received the M.S. degree. During the summers of 1938 and 1939 he was an assistant in the field zoology course at the Louisiana State University Marine Laboratory at Grand Isle, Louisiana.

From 1939 to 1941 he was a fellow in zoology at the University of Illinois. He returned to the Louisiana State University Marine Laboratory during the summer of 1940 to conduct field work for his doctor's thesis. In the spring of 1940 he was elected to active membership in Sigma Xi. He is a member of the American Society of Parasitologists and the American Microscopical Society.

His publications, either singly or as coauthor, are:

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